

PRESSURE-EFFECTED INTERCONNECTION OF A METAL PART AND A PLASTIC PART

FIELD OF THE INVENTION

The present invention relates to a pressure-effectuated interconnection of a metal part and a plastic part which is slipped over the metal part with a press fit, in particular in 5 a fuel injector for internal combustion engines.

BACKGROUND INFORMATION

In a conventional fuel injector, shown in Figure 1 in longitudinal section, a fuel filter 3 is held by a press fit 10 on a metallic valve housing 1 and a metallic valve body 2 which axially projects from valve housing 1. Fuel filter 3 has a cup-shaped base element 4 which is made of plastic and has four cup sections, 4a, 4b, 4c, 4d, whose inner diameters are graduated with respect to each other. Upper cylindrical cup 15 section 4a, having the largest inner diameter, is slipped over valve housing 1 with a press fit. Second cylindrical cup section 4b, contiguous thereto and having a reduced inner diameter, surrounds the upper region of valve body 2 with a radial clearance and has a wall opening 5 into which a filter 20 mesh 6 is inserted in each case. Third cup section 4c, contiguous to second cup section 4b, tapers conically and, at its lower end, transitions into cylindrical fourth cup section 4d which sits on valve body 2 with a press fit. In the region 25 of conical third cup section 4c, radial inflow ducts 7 are formed in valve body 2, which discharge into a central valve chamber 8 on one side and at the outer wall of valve body 2 on

the other side, where they form an intake opening 9 for the fuel flow to valve chamber 8. The other components of the fuel injector such as valve needle 10 which, together with a valve seat 11, releases or seals a spray-discharge orifice 12 in 5 valve chamber 8, solenoid 13 to actuate valve needle 10, and valve-closure spring 14 are well known, for example from Bosch Kraftfahrtechnisches Taschenbuch, [Automotive Handbook] 23<sup>rd</sup> edition, 1999, pages 473 and 476, so that there is no need to discuss them further.

10 In order to achieve appropriate clamping between the valve housing and valve body on one side and the plastic filter on the other side, and also reliable mounting, close tolerances of the parts to be interconnected by compression must be 15 observed, and the plastic part must be subjected to special conditioning. If the compression is too high, the plastic base element of the fuel filter may be damaged or destroyed during the pressing-on operation. If the compression force is too low, the filter may detach easily since the base element made 20 of plastic has a different thermal expansion coefficient than the metal of valve housing and valve body. Swelling of the plastic may also cause expansion of the base element so that the water content of the plastic must be adjusted to a specific value by conditioning the plastic base element.

25 SUMMARY  
A pressure-effected interconnection of a metal part and a plastic part according to an example embodiment of the present invention may have the advantage that it requires no close 30 manufacturing tolerances between the two parts to be pressed together, and that a reliable press fit of the plastic part on the metal part as well as reliable assembly are guaranteed under all operating conditions, also without special conditioning specifications having to be observed for the

plastic part. Shavings possibly peeling off the plastic part during compression are caught in the annular grooves sunk into the wall of the metal part at the foot of the ribs, and are unable to squeeze between the contact surfaces of the pressing pieces, thereby bringing about an undefined pressing surface. The force characteristics during the assembly, i.e., the slide-on force, is constant across a longer production period and exhibit only slight variances, which makes them easy to monitor.

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According to an advantageous embodiment of the present invention, the ribs situated one behind the other are formed such that their projection height beyond the wall of the metal part - viewed transversely to the slide-on direction of the plastic part - increases in the slide-on direction of the plastic part, that is to say, the first rib lying closer to the plastic part in the slide-on direction has a lower projection height than the last rib lying at a greater distance from the plastic part in the slide-on direction. This 15 design of the ribs ensures a slow increase in the compression 20 when the plastic part is slipped over the metal part.

A fuel valve, in particular a fuel injector for internal combustion engines, is also provided, where the pressure- 25 effected interconnection according to the present invention is established between the valve body representing a metal part and a fuel filter representing a plastic part.

#### BRIEF DESCRIPTION OF THE DRAWINGS

30 The present invention is explained in greater detail in the following description on the basis of an exemplary embodiment shown in the figures.

Fig. 1 shows a longitudinal section of a conventional fuel injector.

Fig. 2 shows a longitudinal section of a fuel injector  
5 according to an example embodiment of the present invention in  
a cutaway view.

#### DETAILED DESCRIPTION OF EXAMPLE EMBODIMENT

The pressure-effected interconnection of a metal part and a  
10 plastic part slid over the metal part with a press fit is  
described in the following with the aid of a fuel injector for  
internal combustion engines on whose metallic valve body 22 a  
fuel filter 23 made of plastic is held with a press fit. The  
fuel injector shown only in a cutaway view in Figure 2 in a  
15 longitudinal section has a cylindrical valve body 22 in which  
a valve chamber 28 and at least one inflow duct 27 for the  
supply of fuel into valve chamber 28 are formed. Inflow ducts  
27, of which only one can be seen in Figure 1, discharge into  
valve chamber 28 on one side and have an inflow opening 29 in  
20 the outer wall of cylindrical valve body 22 on the other side.  
While not shown further, but matching the fuel injector  
according to Figure 1, valve chamber 28 has a valve opening,  
or spray bore, which is enclosed by a valve seat. Valve needle  
30, shown in a cutaway portion in Figure 2, dips into valve  
25 chamber 28 and - as in Figure 1 - is pressed onto the valve  
seat by a valve-closure spring, thereby closing the valve  
opening. As in Figure 1, valve needle 30 is actuated by a  
solenoid, which in response to being supplied with an  
excitation current lifts valve needle 30 off the valve seat,  
30 counter to the force of the valve-closure spring, so that the  
valve opening is released and fuel is spray-discharged from  
valve chamber 28. The solenoid is in turn accommodated in  
valve housing 21. Valve body 22 is inserted into valve housing  
21 from below and connected to valve housing 21 in the region

of a valve-body section having a larger diameter in a fluid-tight manner by a circumferential welded seam 31. In the process, an annular chamber 32 into which inflow ducts 27 discharge by way of their inflow openings 29 is produced 5 between inner wall 211 of valve housing 21 and cylinder wall 221 of valve body 22. The fuel flow to valve chamber 28 is implemented via annular chamber 32 and inflow ducts 27.

Fuel filter 23 has a hollow-cylindrical base element 24 made 10 of plastic whose inside diameter is slightly larger than the outer diameter of valve body 22. Wall cutouts, i.e., traversing wall openings 25 via which inflow ducts 27 are connected to annular chamber 34, are introduced into base element 24. Each wall opening 25 is covered by a filter mesh 15 26. Fuel filter 23 is slid over valve body 22 in the direction of arrow 33.

To achieve a reliable, tight press fit of fuel filter 23 on valve body 22 without high demands on the manufacturing 20 tolerances of both components, a plurality of circumferential ribs - in this case, three ribs 34, 35, 36 - have been formed on cylinder wall 221 of valve body 22, which are arranged one behind the other in the axial direction of valve body 22, i.e., in slide-on direction 33 of fuel filter 23. Each 25 circumferential rib 34, 35, 36 has a back 37 which radially rises in slide-on direction 33 of fuel filter 23, and a flank 38 which sharply falls from the back end, radial flank 38 extending radially in the exemplary embodiment of Figure 2. As can be seen from Figure 2, the radial projection height of 30 ribs 34, 35, 36 increases in slide-on direction 33 of fuel filter 23, so that first rib 34 has the smallest projection height and thus the smallest radial measure of flank 38, and last rib 36 has the greatest projection height and thus the greatest radial measure of flank 38. Situated in front of each

rib 34, 35, 36 in slide-on direction 33 of fuel filter 23 is an annular groove 39, which is introduced into cylinder wall 221 directly at the foot of back 37.

5 During installation fuel filter 23 is pressed over ribs 34 through 36 by its base element 24 made of plastic. The pressing over of ribs 34 through 36 is facilitated by the angled slope of back 37. The stepped increase in the projection measure of ribs 34 through 36 beyond cylinder wall  
10 221 ensures a slow increase in the pressure. The pressure itself acts directly on ribs 34 through 36, as line contact and not across the full pressure path, which causes base element 24 to deform slightly. In addition, base element 24 is subjected to a locally high line pressure, which is more  
15 advantageous for the plastic base element than cylindrical loading. When fuel filter 23 is completely pressed onto valve body 22, base element 24 interlocks with ribs 34 through 36. Shavings and scrapings of plastic that may detach when base element 24 is pressed on may collect in annular grooves 39 at  
20 the foot of back 37 of ribs 34 through 36 and will not be pushed toward the outside. This also prevents the plastic shavings or splinters from being pushed through the gap between base element 24 and valve body 22 so that they do not become wedged there. They are also unable to reach the area of  
25 inflow ducts 27 and be washed into the valve seat region by the fuel via inflow ducts 27.

The present invention is not limited to the exemplary embodiment of a fuel injector shown and described in Figure 2.  
30 It is also possible to implement the press fit between fuel filter 23 according to Figure 1 on the one side, and valve housing 1 and valve body 2 on the other side, in the manner described.

The pressure-effectuated interconnection according to the present invention of a metal part and a plastic part slid over the metal part with a press fit, which was described using the example of a fuel injector, may generally be used for any  
5 plastic-metal part interconnection.